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Revision History

10. Revision No.	11. Description of Revision
Rev 00	Initial Issue

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TABLES

1. PURPOSE

The objective of this calculation is to provide in-drift physical properties required by the drift-scale models (both two- and three-dimensional) used in total system performance assessments (TSPA). The physical properties include waste package geometry, waste package thermal properties, emplacement drift geometry including backfill and invert geometry and properties (both thermal and hydrologic), drip shield geometry and thermal properties, all tabulated in a single source. This calculation is performed under quality assurance procedure AP-3.12Q, Rev. 0/ICN 1, *Calculations.* The work for this calculation is directed by the development plan TDP-EBS-HS-000002, *Development Plan, Tabulated In-Drift Geometric and Thermal Properties Used In Drift-Scale Models for TSPA-SR* (CRWMS M&O 1999g) which was developed according to procedure AP-2.13Q, Rev. 0/ICN 1, *Technical Product Development Planning.*

2. METHOD

The methods used to compute the required in-drift properties include standard principles of geometry to compute the various length dimensions and fundamental heat transfer principles to determine the effective thermal properties. The data generated by this calculation was submitted to the technical data management system (TDMS) according to AP-SIII.3Q, *Submittal and Incorporation of Data to the Technical Data Management System*, as specified in the development plan. With regard to the development of this calculation, the control of electronic management of data was evaluated in accordance with AP-SV.1Q, *Control of the Electronic Management of Data*. The evaluation (Andrews 2000) determined that current work processes and procedures are adequate for the control of electronic management of data for this activity.

3. ASSUMPTIONS

3.1 The placement of the waste package is concentric within the drip shield. The basis for this assumption is that this waste package location was employed in *ANSYS Calculations in Support of Enhanced Design Alternatives* (CRWMS M&O 1999a, page 25 of 41 through 26 of 41) for the License Application Design Selection (LADS) study. This assumption is applied in the calculation section (section 5) when specifying the emplacement drift geometry (e.g., the waste package placement under the drip shield).

3.2 Design information found in Design Input Transmittals that have been superceded is still valid if the superceding Design Input Transmittal does not specifically supercede the respective design information. The basis for this assumption is that if the newer design input transmittals intended to supercede specific information in older transmittals, then this would have been included in the new transmittal. This assumption is specifically used for *Transmittal for Repository Subsurface Design Information to Support Total System Performance Assessment-Site Recommendation (TSPA-SR)* (CRWMS M&O 1999h, Item 3) which was superceded by input transmittal *Request for Repository Subsurface Design Information to Support TSPA-SR* (CRWMS M&O 1999d).

3.3 The length of the naval Spent Nuclear Fuel (SNF) waste package is 5.57 meters. This corresponds to the length of the "regular" naval SNF waste package (CRWMS M&O 1999b, Table 8). This assumption is used in Section 5.2.

3.4 The radius of the Department of Energy (DOE)/Other waste packages is the same as that of naval SNF. There is no information available on the radius of the DOE/Other waste packages. The basis for this assumption is that, since the heat load curves (CRWMS M&O 1999b, page 4/28) as well as the length of the DOE/Other waste package and the "regular" naval SNF waste package are both 5.570 meters (CRWMS M&O 1999b, pages 25/28 and 26/28), it is reasonable to assume that their radius will be the same. Note: "long" naval SNF waste packages are 6.205 meters long (CRWMS M&O 1999b, page 26/28). This assumption is used in Section 5.2.

4. USE OF COMPUTER SOFTWARE AND MODELS

No software/routines or models have been utilized for this calculation.

5. CALCULATION

The primary inputs to this calculation are in the form of the design transmittal process. This process is governed by the quality assurance procedure QAP-3-12, *Transmittal of Design Input* (prior to Process Validation and Reengineering [PVAR]) and AP-3.14Q, *Transmittal of Input*. A listing of design transmittals is given in table 1.

Table 1. Design Input Transmittals

Item Defined	Input Tracking Number	Date Approved	QA Status[2]
Waste Package Diameters and Lengths, Waste Package Thermal Properties (Density, Thermal Conductivity, Thermal Diffusivity), Number of Waste Packages.	PA-WP-99184.T, (CRWMS M&O 1999b) PA-WP-99184.Ta (CRWMS M&O 1999c)	May 19, 1999 June 11, 1999	NQ NQ
Backfill and Invert Geometric, Thermal, and Hydrologic Properties	PA-SSR-99218.Ta (CRWMS M&O 1999d)	August 18, 1999	NQ
Emplacement Drift Geometry	PA-SSR-99218.Tb (CRWMS M&O 1999e)	August 20, 1999	NQ
Drip Shield Thermal Properties	PA-SSR-99218.T[1] (CRWMS M&O 1999h)	July 8, 1999	NQ
Drip Shield Thickness	SSR-WP-99242.T (CRWMS M&O 1999f)	August 5, 1999	NQ

[1] Thermal properties of the drip shield are in item 3 of this transmittal (also in Section 3.4 of CRWMS M&O 1999a).
[2] NQ is not qualified (or unqualified).

5.1 BACKFILL GEOMETRY (CRWMS M&O 1999e)

From *Request for Repository Subsurface Design Information to Support TSPA-SR* (CRWMS M&O 1999e, page 2/2), the height of the backfill spoil peak (maximum location of backfill in the drift) above the waste package centerline is computed as the following (assumption 3.1 is applied here as the waste package is placed concentrically under the drip shield):

Height = Drift diameter – Location of spoil peak below drift crown (top of drift) – Invert height – Distance of the waste package centerline above the invert (EQN. 1)

= 5.5 m – 0.5 m – 0.606 m – 1.339 m = 3.055 m (EQN. 2)

Using this and the angle of repose of backfill (α), the minimum depth of backfill cover is computed from the geometric relationship:

$$r + G + D = (\text{Height}) * \cos \alpha \quad \text{(EQN. 3)}$$

where r is the waste package outer radius, G is the total thickness of the air gap (between waste package outer surface and the drip shield inside surface) plus the drip shield, and D is the minimum depth of backfill cover. For r + G = 1.251 m, $\alpha = 26°$, and Height = 3.055 m, the minimum depth of backfill cover is D = 1.495 m. D is the minimum dimension measured from the outside surface of the drip shield at a right angle to the sloping top surface of the backfill. The backfill spoil peak is located 2.25 meters above the emplacement drift springline (drift centerline-horizontal), as shown in figure 2.

L = Location of backfill spoil peak above emplacement drift springline (EQN. 4)

= Drift radius – Location of spoil peak below drift crown (top of drift) (EQN. 5)

= 5.5m/2 – 0.5m = 2.25 m (EQN. 6)

The final backfill location required for the models is where the sloping backfill intersects the emplacement drift wall. This is found by equating the equations of a straight line for the backfill surface to a circle for the emplacement drift wall. For a coordinate system centered at the drift centerline, the equations, based on geometric relationships, are:

$$y = -(\tan\alpha)x + B$$
$$x^2 + y^2 = R^2 \quad \text{(EQN. 7)}$$

where $R = 2.75$ m, $\alpha = 26°$, and $B = 2.25$ m. The equations are solved for the horizontal distance, x, equal to 2.56 meters and vertical distance, y, equal to 1.0 meter. This vertical distance represents the location above the drift springline where the backfill intersects the drift wall. All relevant backfill geometric properties can be found in table 2 and figure 2 at the end of the section.

5.2 WASTE PACKAGE GEOMETRY (CRWMS M&O 1999b and CRWMS M&O 1999c)

An effective outer waste package diameter (d_O) is computed as an average value based on the total number of different types of waste packages. The calculation is based upon waste package inner and outer diameters in *Enhanced Design Alternative (EDA) II Repository Estimated Waste Package Types and Quantities* (CRWMS M&O 1999b, Table 8) and the waste package inventory by type in *Enhanced Design Alternative (EDA) II Repository Estimated Waste Package Types and Quantities* (CRWMS M&O 1999c, page 15/45). The diameter of the DOE/Other waste packages is approximated to be the same as the naval SNF waste packages (Assumption 3.4).

$$d_o = \frac{\sum (\#WastePackages)_{type} (d_{o,wastepackage})_{type}}{\sum (\#WastePackages)_{all\ types}} \qquad \text{(EQN. 8)}$$

$$d_o = \frac{4279}{9965}(1.564) + \frac{87}{9965}(1.564) + \frac{158}{9965}(1.250) + \frac{2889}{9965}(1.594) + \frac{6}{9965}(1.238) + \frac{1249}{9965}(2.030) + \frac{414}{9965}(2.030) + \frac{285}{9965}(1.869) + \frac{598}{9965}(1.869) \approx 1.67m \qquad \text{(EQN. 9)}$$

The nine terms in equation (9) represent: 21-Pressurized Water Reactor (PWR) absorber plates, 21-PWR control rods, 12-PWR long, 44-Boiling Water Reactor (BWR) absorber plates, 24-BWR thick absorber plates, 5-Defense High Level Waste (DHLW) co-disposal, 5-DHLW co-disposal long, naval SNF "combined", and DOE/Other. The effective inner waste package diameter (d_i) is calculated in a similar manner,

$$d_i \approx 1530mm = 1.53m \qquad \text{(EQN. 10)}$$

For an average waste package with an outer diameter of 1.67 m and an inner diameter of 1.53 m, the thickness (which accommodates two material types) is 0.14 meters (see Figure 1). The inner material is stainless steel and the outer material is alloy-22 (CRWMS M&O 1999b, Table 8). The radius, r_t, corresponds to the radius of the transition between the two layers. The inner material (Stainless Steel 316NG) has a constant thickness of 50 mm for each waste package type (CRWMS M&O 1999b, Table 8). An approximate waste package used to determine the effective waste package thermal properties (required in the drift-scale models) is based on equations (9) and (10) and the inner material thickness of 50 mm:

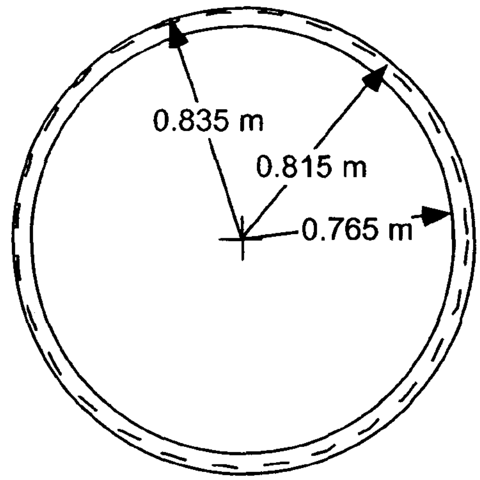

Figure 1. Composite Waste Package Including Inner Stainless Steel 316NG and Outer Alloy 22 (r_t = 0.815 m).

Although the 3-D drift-scale models use the actual waste package lengths and 2-D models use a unit length, some models used in TSPA require an average waste package length. An average waste package length can be computed in the same manner as the average waste package outer diameter was in equation (9). The effective average waste package length (L_e) can be computed from the waste package lengths in *Enhanced Design Alternative (EDA) II Repository Estimated Waste Package Types and Quantities* (CRWMS M&O 1999b, Table 8) for all WP types except DOE/Other and from *Enhanced Design Alternative (EDA) II Repository Estimated Waste Package Types and Quantities* for DOE/Other waste package length (CRWMS M&O 1999c page 15/45) and the waste package inventory by type (CRWMS M&O 1999c page 15/45):

$$L_e = \frac{\sum (\#WastePackages)_{type} (L_{wastepackage})_{type}}{\sum (\#WastePackages)_{all\,types}} \qquad \text{(EQN. 11)}$$

$$L_e = \frac{4279}{9965}(5.305) + \frac{87}{9965}(5.305) + \frac{158}{9965}(5.791) + \frac{2889}{9965}(5.275) + \frac{6}{9965}(5.245) + \frac{1249}{9965}(3.73) + \frac{414}{9965}(5.357) + \frac{285}{9965}(5.57) + \frac{598}{9965}(5.57) \approx 5.13m \qquad \text{(EQN. 12)}$$

The nine terms in equation (12) represent: 21-PWR absorber plates, 21-PWR control rods, 12-PWR long, 44-BWR absorber plates, 24-BWR thick absorber plates, 5-DHLW co-disposal, 5-DHLW co-disposal long, naval SNF ("combined" for inventory, "regular" for length), and DOE/Other. The average waste package length of 5.13 meters given in equation (12) includes the skirt length. The length of the DOE/Other waste packages was assumed to be the same as the length of the navy SNF waste packages (Assumption 3.3).

5.3 AIR GAP GEOMETRY (CRWMS M&O 1999e and CRWMS M&O 1999f)

For a waste package placed concentrically under the drip shield (refer to assumption 3.1 in section 3), thickness of the air gap region between the waste package outer surface and the drip shield inner surface can be found. The distance from the center of the waste package to the outside surface of the drip shield is 1.251 m (CRWMS M&O 1999e, page 2/2). For the waste package diameter given in equation (9) and the drip shield thickness of 0.02 meters (CRWMS M&O 1999f, page 1/1), the air gap between the waste package outer surface and the drip shield inner surface is:

$$t_{ag-ds} = 1.251 - \frac{1.67}{2} - 0.02 = 0.396m \qquad \text{(EQN. 13)}$$

For a waste package placed concentrically under the drip shield, the air gap between the bottom of the waste package surface and the top of the invert is:

$$t_{ag-inv} = 1.339 - \frac{1.67}{2} = 0.504\,m \qquad \text{(EQN. 14)}$$

5.4 WASTE PACKAGE THERMAL PROPERTIES (CRWMS M&O 1999b)

Composite waste package thermal properties (e.g., specific heat, thermal conductivity, and density) are calculated using the geometry specified in figure 1 and thermophysical property values given in *Enhanced Design Alternative (EDA) II Repository Estimated Waste Package Types and Quantities* (CRWMS M&O 1999b). An average value for the thermal conductivity and specific heat is computed initially. For the stainless steel inner material (CRWMS M&O 1999b, Table 10), an appropriate temperature range to compute an average value is (21°C – 260°C). The average thermal conductivity and specific heat are 15.3 W/m-K and 513.24 J/kg-K, respectively. For the alloy-22 outer material (CRWMS M&O 1999b, Table 11), an appropriate temperature range to compute an average is (48°C – 300°C). The average thermal conductivity and specific heat are 12.525 W/m-K and 435.25 J/kg-K, respectively. A composite waste package thermal conductivity can be computed per unit length of waste package based on a series resistance argument. For two materials in direct contact (as shown in figure 1), the composite thermal conductivity is computed as the following:

$$R_{eff} = R_{SS} + R_{A22} \qquad \text{(EQN. 15)}$$

where R_{eff} is the composite thermal resistance, R_{SS} is the thermal resistance of stainless steel, and R_{A22} is the thermal resistance of alloy-22. Equation (15) is solved for a composite thermal conductivity in terms of cylinder diameters and thermal conductivities as the following (Incropera and DeWitt 1985, p. 77, eqn. 3.27):

$$k_{eff} = \frac{\ln\left(\frac{d_o}{d_i}\right)}{\frac{\ln\left(\frac{r_t}{d_i/2}\right)}{k_{SS}} + \frac{\ln\left(\frac{d_o/2}{r_t}\right)}{k_{A22}}} = 14.42\frac{W}{m-K} \qquad \text{(EQN. 16)}$$

where d_o, d_i, r_t are given in figure 1, and k_{SS} = 15.3 W/m-K and k_{A22} = 12.525 W/m-K. The material densities for stainless steel and alloy-22 are 7980 and 8690 kg/m^3, respectively (CRWMS M&O 1999b, Table 9). With this and figure 1, the composite density of the waste package shell is computed as:

$$\rho_{eff} = \frac{m_T}{V_T} = \frac{V_{SS}\rho_{SS} + V_{A22}\rho_{A22}}{V_T} = 8189.2\frac{kg}{m^3} \qquad \text{(EQN. 17)}$$

where m_T is the total mass and V_T is the total volume. V_{SS} and V_{A22} are the volumes of stainless steel and alloy-22 and are calculated using figure 1. The composite specific heat is computed as:

$$C_{p_{eff}} = \frac{V_{SS}\rho_{SS}}{V_T\rho_{eff}}C_{p_{SS}} + \frac{V_{A22}\rho_{A22}}{V_T\rho_{eff}}C_{p_{A22}} = 488.86\frac{J}{kg-K} \qquad \text{(EQN. 18)}$$

5.5 DRIP SHIELD THERMAL PROPERTIES (CRWMS M&O 1999a)

As in the case of the previous materials, an appropriate temperature range is used to compute the average thermophysical properties of the drip shield. The thermophysical properties of the titanium drip shield are taken from *ANSYS Calculations in Support of Enhanced Design Alternative* (CRWMS M&O 1999a, p. 21 of 41). For a temperature range of 21°C – 260°C, the average thermal conductivity, specific heat, and thermal diffusivity are 20.55 W/m-K, 551.32 J/kg-K, and 8.28x10^{-6} m^2/s, respectively. The density of the drip shield is computed from these as:

$$\bar{\rho} = \frac{\bar{k}}{\bar{\alpha}\bar{C}_p} = 4501.7\frac{kg}{m^3} \qquad \text{(EQN. 19)}$$

where k is the thermal conductivity, C_p is the specific heat, and α is the thermal diffusivity. The overbar indicates an average quantity. The emissivity of this material is given as ε = 0.63 (CRWMS M&O 1999a, p. 21 of 41).

5.6 INVERT AND BACKFILL HYDROLOGIC AND THERMAL PROPERTIES (CRWMS M&O 1999d)

The backfill and invert quantities as presented in *Request for Repository Subsurface Design Information to Support TSPA-SR* (CRWMS M&O 1999d, pages 1 and 2 of 16 and 8 and 10 of 16), respectively, are converted to values more readily applied to the thermal hydrologic process-level models used by TSPA. The invert and backfill van Genuchten alpha parameter is converted from units of cm^{-1} to Pa^{-1}. The resulting values are:

Invert $$0.12\ cm^{-1} * (100\ cm/m) / \{1000\ kg/m^3 * 9.81\ m/s^2\} = 1.2232 \times 10^{-3}\ Pa^{-1} \quad \text{(EQN. 20)}$$

and,

Backfill $$0.027\ cm^{-1} * (100\ cm/m) / \{1000\ kg/m^3 * 9.81\ m/s^2\} = 2.7523 \times 10^{-4}\ Pa^{-1} \quad \text{(EQN. 21)}$$

for invert and backfill, respectively. The residual liquid saturation is converted from a volumetric liquid saturation to liquid saturation by dividing the porosity. The resulting values are:

Invert $$S_{rl,\ invert} = \text{(volumetric saturation)/(porosity)} = 0.05/0.545 = 0.092 \quad \text{(EQN. 22)}$$

and,

Backfill $$S_{rl,\ backfill} = 0.01/0.41 = 0.024 \quad \text{(EQN. 23)}$$

for invert and backfill, respectively. These and the remaining invert and backfill property values are given in table 2 in the next section.

A summary of all geometric and thermophysical properties required by the drift-scale models used in TSPA-SR process-level models is given in table 2 and figure 2 in the next section.

6. RESULTS

Since unqualified data were used in the development of the results presented in this section, the results should be considered TBV. However, any use of the data from this calculation for inputs into documents supporting construction, fabrication, or procurement is required to be controlled as TBV in accordance with appropriate procedures. This calculation does not contain any assumptions that need to be confirmed prior to the use of the results of the calculation.

This document may be affected by technical product input information that requires confirmation. Any changes to the document that may occur as a result of completing the confirmation activities will be reflected in subsequent revisions. The status of the input information quality may be confirmed by review of the Document Input Reference System database.

The in-drift geometry and property data summarized within Table 2 and Figure 2 have been submitted to TDMS and are unqualified (NQ). The data tracking number (DTN) for the data set is: SN9908T0872799.004 and is tracked as TBV-3471.

Table 2. In-Drift Data for Drift-Scale Models for TSPA-SR

Model Input	Value	Source
Drift diameter	5.5 meters	PA-SSR-99218.Tb (CRWMS M&O 1999e)
Waste package outer diameter	1.67 meters	Calculated using PA-WP-99184.T (CRWMS M&O 1999b)
Location of waste package center above bottom of drift	1.945 meters	PA-SSR-99218.Tb (CRWMS M&O 1999e)
Location of waste package center below the springline	0.805 meters	PA-SSR-99218.Tb (CRWMS M&O 1999e)
Angle of Repose	26°	PA-SSR-99218.Tb (CRWMS M&O 1999e)
Minimum depth of backfill cover (this occurs at an angle equivalent to the angle of repose measured off the vertical drawn from the waste package centerline)	1.495 meters	Calculated using PA-SSR-99218.Tb (CRWMS M&O 1999e)
Drip shield thickness	0.02 meters	B00000000-01717-0210-00074 Rev00 (CRWMS M&O 1999a)
Air gap between waste package surface and the inside of drip shield	0.396 meters	Calculated using PA-SSR-99218.Tb (CRWMS M&O 1999e) and waste package outer diameter above and dripshield thickness from SSR-WP-99242.T (CRWMS M&O 1999f)
Location of backfill spoil peak (this is the location where the top of the backfill intersects the vertical drawn from the drift centerline) above the drift springline	2.25 meters	Calculated using PA-SSR-99218.Tb (CRWMS M&O 1999e)
Backfill/drift wall intersection point (distance above the springline at the drift wall intersection)	1.0 meter	Calculated using PA-SSR-99218.Tb (CRWMS M&O 1999e)
Air gap above invert and below waste package surface	0.504 meters	Calculated using PA-SSR-99218.Tb (CRWMS M&O 1999e) and waste package outer diameter above and dripshield thickness from SSR-WP-99242.T (CRWMS M&O 1999f)
Inside radius of drip shield	1.231 meters	Evident from PA-SSR-99218.Tb (CRWMS M&O 1999e) and drip shield thickness
Top of invert as measured from bottom of drift	0.606 meters	PA-SSR-99218.Tb (CRWMS M&O 1999e)
Waste package thermal conductivity	14.42 W/m-K	Calculated using PA-WP-99184.T (CRWMS M&O 1999b)
Waste package shell density	8189.2 kg/m^3	Calculated using PA-WP-99184.T (CRWMS M&O 1999b)
Waste package specific heat	488.86 J/kg-K	Calculated using PA-WP-99184.T (CRWMS M&O 1999b)
Average waste package length (for models requiring a single average waste package length; it is not used for discrete drift-scale models including different waste package types)	5.13 meters	Calculated using PA-WP-99184.T (CRWMS M&O 1999b)

Table 2. In-Drift Data for Drift-Scale Models for TSPA-SR (Continued)

Waste package spacing	0.1 meter	PA-SSR-99218.T (CRWMS M&O 1999h), Item 2 Page 9 of 15
Drip shield thermal conductivity	20.55 W/m-K	Average Value Calculated using B00000000-01717-0210-00074 Rev00 (CRWMS M&O 1999a), Table 11
Drip shield specific heat	551.32 J/kg-K	Average Value Calculated using B00000000-01717-0210-Rev00 Rev00 (CRWMS M&O 1999a), Table 11
Drip shield density	4501.7 kg/m^3	Average Value Calculated using B00000000-01717-0210-00074 Rev00 (CRWMS M&O 1999a), Table 11
Drip shield emissivity	0.63	B00000000-01717-0210-00074 Rev00 (CRWMS M&O 1999a)
Invert intrinsic permeability	6.152x10^{-10} m^2	PA-SSR-99218.Ta (CRWMS M&O 1999d), Item 2 Page 9 of 16
Invert porosity	0.545	PA-SSR-99218.Ta (CRWMS M&O 1999d), Item 2 Page 8 of 16
Invert grain density	2530 kg/m^3	PA-SSR-99218.Ta (CRWMS M&O 1999d), Item 2 Page 8 of 16
Invert residual liquid saturation	0.092	Calculated from PA-SSR-99218.Ta (CRWMS M&O 1999d), Item 2 Page 8 of 16 and 10 of 16
Invert van Genuchten alpha	1.2232x10^{-3} Pa^{-1}	Calculated from PA-SSR-99218.Ta (CRWMS M&O 1999d), Item 2 Page 10 of 16
Invert van Genuchten n	2.7	PA-SSR-99218.Ta (CRWMS M&O 1999d), Item 2 Page 10 of 16
Invert specific heat	948 J/kg-K	PA-SSR-99218.Ta (CRWMS M&O 1999d), Item 2 Page 14 of 16
Invert emissivity	0.93	PA-SSR-99218.Ta (CRWMS M&O 1999d), Item 2 Page 14 of 16
Invert thermal conductivity (dry)	0.66 W/m-K	PA-SSR-99218.Ta (CRWMS M&O 1999d), Item 2 Page 13 of 16
Backfill intrinsic permeability	1.43x10^{-11} m^2	PA-SSR-99218.Ta (CRWMS M&O 1999d), Item 2 Page 2 of 16
Backfill porosity	0.41	PA-SSR-99218.Ta (CRWMS M&O 1999d), Item 2 Page 1 of 16
Backfill grain density	2700 kg/m^3	PA-SSR-99218.Ta (CRWMS M&O 1999d), Item 2 Page 1 of 16
Backfill residual liquid saturation	0.024	Calculated from PA-SSR-99218.Ta (CRWMS M&O 1999d), Item 2 Pages 1 and 2 of 16
Backfill van Genuchten alpha	2.7523x10^{-4} Pa^{-1}	Calculated from PA-SSR-99218.Ta (CRWMS M&O 1999d), Item 2 Page 2 of 16
Backfill van Genuchten n	2.0	PA-SSR-99218.Ta (CRWMS M&O 1999d), Item 2 Page 2 of 16
Backfill specific heat	795.492 J/kg-K	PA-SSR-99218.Ta (CRWMS M&O 1999d), Item 2 Page 4 of 16
Backfill emissivity	0.93	PA-SSR-99218.Ta (CRWMS M&O 1999d), Item 2 Page 4 of 16
Backfill thermal conductivity (dry)	0.33 W/m-K	PA-SSR-99218.Ta (CRWMS M&O 1999d), Item 2 Page 4 of 16

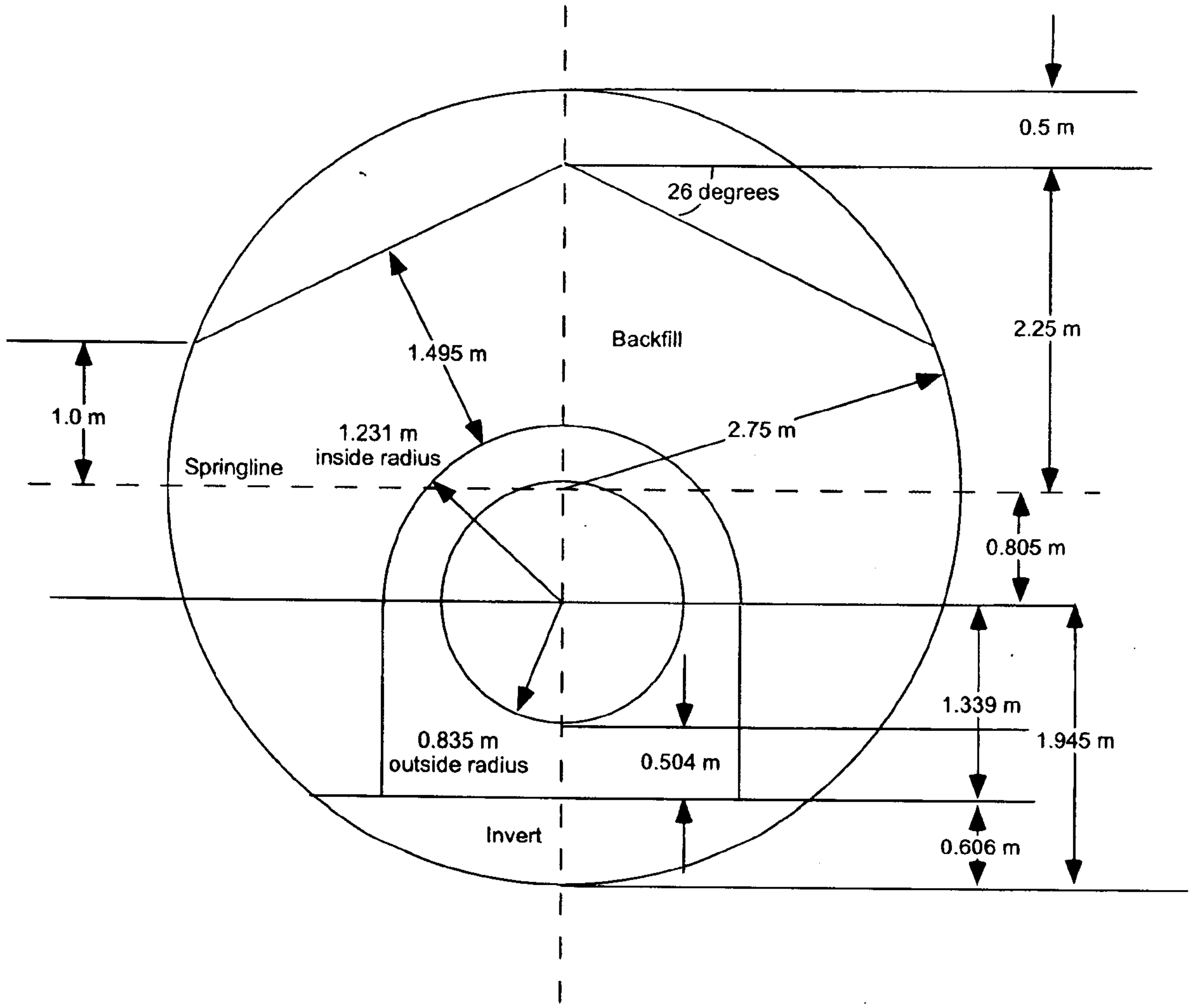

Figure 2. Sketch Corresponding to In-Drift Data for Drift-Scale Models for TSPA-SR.

7. REFERENCES

7.1 Andrews, R.W. 2000. "AP-SV.1Q Control of the Electronic Management of Data Evaluation for Natural Systems Analysis/Model Reports." Letter from R.W. Andrews (CRWMS M&O) to S.P. Mellington (DOE/YMSCO), April 11, 2000, LV.PA.RWA.04/00-039, with enclosure. ACC: MOL.20000412.0785.

7.2 CRWMS M&O 1999a. *ANSYS Calculations in Support of Enhanced Design Alternatives.* B00000000-01717-0210-00074 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990218.0240.

7.3 CRWMS M&O 1999b. *Enhanced Design Alternative (EDA) II Repository Estimated Waste Package Types and Quantities.* Design Input Transmittal PA-WP-99184.T. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990526.0188.

7.4 CRWMS M&O 1999c. *Enhanced Design Alternative (EDA) II Repository Estimated Waste Package Types and Quantities.* Design Input Transmittal PA-WP-99184.Ta. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990809.0289.

7.5 CRWMS M&O 1999d. *Request for Repository Subsurface Design Information to Support TSPA-SR.* Input Transmittal PA-SSR-99218.Ta. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990901.0312.

7.6 CRWMS M&O 1999e. *Request for Repository Subsurface Design Information to Support TSPA-SR.* Input Transmittal PA-SRR-99218.Tb. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19990901.0311.

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8. ATTACHMENTS

There are no Attachments required for the calculation.